

XVI. NEW AND INTERESTING PEDUNCULATE CIRRIPEDES FROM INDIAN SEAS.

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(Plates xxxiii-xxxiv.)

For some years past the main biological work of the 'Investigator' has been carried out in comparatively shallow water, and the Surgeon-Naturalists (Capts. R. B. Seymour Sewell and T. L. Bomford) have devoted considerable attention to the littoral and sub-littoral fauna. The result has been, so far as the Cirripedia Pedunculata are concerned, to add several new and interesting species to the fauna of the Bay of Bengal. I propose here to describe or notice these, together with a species of which specimens have been obtained by Mr. J. Hornell off the coast of Baluchistan.

Family SCALPELLIDAE.

Scalpellinae, Pilsbry, *U.S. Nat. Mus. Bull.* 60, p. 4 (1907).

Pollicipedidae Annandale, *Mem. Ind. Mus.* II, p. 63 (1909).

Of this family four species have now to be added to the Indian fauna, one belonging to the genus *Lithotrya* and three to the subgenus *Smilium* of the genus *Scalpellum*.

Genus *Scalpellum*, Leach.

Subgenus *Smilium* Gray.

Annandale, *Rec. Ind. Mus.* V, p. 145 (1910).

The species of this subgenus often inhabit shallower water than those of *Scalpellum* (s.s). It is, therefore, not surprising that the exploration of the coast of Burma should have resulted in the discovery of forms not hitherto known from these seas, for most of the biological work of the 'Investigator' has been carried out hitherto in much deeper water. The three species here noted have all been found already elsewhere in the Oriental Region.

Scalpellum (*Smilium*) *kampeni*, Annandale.

Rec. Ind. Mus. III, p. 267, figs. 1-4 (1909); *Vid. Med. naturhist. Foren. Köbenhavn*, 1910, p. 82.

This species was originally discovered by Dr. P. van Kampen in 13-16 fathoms off the coast of Sumatra. It has since been found off Singapore and in the Gulf of Siam (by Dr. Th. Mortensen)

at depths of from 15–30 fathoms. Several specimens were obtained by Capt. Sewell off the coast of Burma in comparatively shallow water. Precise details as to their *provenance* are not at present forthcoming.

Scalpellum (Smilium) rostratum, Darwin.

Darwin, *Mon. Cirr. Lepadidae*, p. 259, pl. iv, fig. 7 (1851).

Hoek, *Siboga-Exp.*, Mon. XXXIa, p. 65, pl. v, fig. 13 (1907).

Sewell, *Journ. As. Soc. Bengal (n.s.)* IX, p. 329 (1913).

Originally described from the Phillipines (20 fathoms), this species was taken at several places in the Malay Archipelago by the 'Siboga' in depths of from $8\frac{1}{2}$ to $61\frac{1}{2}$ fathoms. A young specimen was obtained by Capt. Sewell off the coast of Burma in 50 fathoms ('Investigator' sta. 395: lat. $13^{\circ} 29' N.$, long. $97^{\circ} 30' E.$).

Scalpellum (Smilium) sinense, Annandale.

(Pls. xxxiii, xxxiv, fig. 1.)

Ved. Med. naturhist. Foren. Köbenhavn, 1910, p. 211, pl. iii, fig. 3.

This species was first reported from the China Sea. Capt. Bomford obtained three specimens on the spines of a sea-urchin of the family Cidaridae (together with the types of *Heteralepas reticulata*, described below) in 60 fathoms in the Mergui Archipelago (sta. 534: lat. $12^{\circ} 4' N.$, long. $96^{\circ} 44' E.$). These specimens, which were taken in April, have no males attached, although one is ovigerous.

The proportions of the valves and the shape of the terga vary somewhat, the external membrane is much denser in some individuals than in others, and the form of the mandible is extraordinarily variable. In the specimen from China first dissected there were five main teeth (including the inner angle) with a small subsidiary tooth between the first two; in one Burmese example there are six subequal teeth, but in another there are seven teeth, the fourth of which has, however, almost the nature of a subsidiary tooth. The following appear to be specific characters:—the appendage as a whole is never very strongly curved, the first main tooth is never either much larger than or widely separated from the second; all the teeth (except the small subsidiary ones) are of moderate size, subequal and about equidistant; the inner angle forms a blunt tooth not much larger than the others and clothed with short spines or hairs.

The eggs are broadly oval in outline, 0.4 mm. long by 0.29 mm. broad. They are present only in comparatively small numbers, each lamella containing about 100. That is to say, each barnacle produces about 200 eggs at a time.

Genus Lithotrya, G. B. Sowerby.

The species of this genus are usually found boring in coral-reefs, among the shells of molluscs or in soft limestone.

The Indian species are still imperfectly known, having been recorded only from outlying groups of islands such as the Maldives and the Nicobars.

Lithotrya (Conchotrya) valentiana (Gray).

Darwin, *Mon. Cirr. Lepadidae*, p. 371, pl. viii, fig. 5 (1851).

Gruvel, *Mon. Cirrh.*, p. 104, fig. 113 (1905).

Mr. Hornell took two specimens of this species in cavities in limestone rocks on the shore of Churnah I. off the coast of Baluchistan and has kindly presented them to the Indian Museum. The original specimens were embedded in an oyster-shell from the Red Sea, and others have since been found in a similar position at Zanzibar.

L. valentiana is distinguished from all others of the genus by the absence of lateral valves. The rostrum is rudimentary and the scuta, terga and carina lock together in an unusually intricate manner. These characters are perhaps sufficient to justify the retention of Gray's name *Conchotrya* as that of a subgenus of which this species would be the type and, so far as is known, the sole representative. The peduncle is normal in shape. It is covered with minute chitinous tubercles and bears a transverse suboval calcareous plate on its posterior surface at or near the base.

Family LEPADIDAE.

Subfamily *Oxynaspidinae*.

***Oxynaspis indica*, Annandale.**

Oxynaspis celata subsp. *indica*, Annandale, *Mem. Ind. Mus.* II, p. 69, pl. vii, fig. 10 (1909).

I think it best on the whole to recognize the Indian *Oxynaspis* as a distinct species, although it is closely allied to the one from the Atlantic described by Darwin as *O. celata*. It has a narrower capitulum than that form and neither the shape of the valves nor the structure of the appendages is quite the same.

I was wrong (*loc. cit.*, 1909) in differing from Darwin as to the nature of the spiny covering of the shell in this genus. In a young specimen recently examined the antipatharian has produced a flat, spiny growth over the valves, and from this growth normal branches are actually given off at the tip of each tergum of the cirripede, reaching a length of several millimetres. There can, therefore, be no doubt that the external covering of the barnacle is produced, not by the animal itself, but by the organism to which it is attached—as Darwin originally stated.

O. indica occurs on both sides of the Bay of Bengal at depths of from 15 to 20 fathoms. I have recently found two small specimens on an antipatharian from 'Investigator' station 464 (S. of Ceylon: lat. 5° 56' N., long. 75° 45' E.: 52-68 faths.).

Subfamily *Lepadinae*.Genus *Alepas* (Rang), Pilsbry.

Alepas, Pilsbry, *U.S. Nat. Mus. Bull.* 60, p. 103 (1907); Annandale, *Mem. Ind. Mus.* II, p. 64 (1909).

Pelagic Lepadinae with translucent or transparent tissues, without calcareous valves or with a pair of scuta only, without a muscular lining to the capitulum, without anal appendages or with uniarticulate anal appendages, with straight or nearly straight cirri of not more than about 14 joints to each ramus, with (in one species) 5 lateral filaments on each side. The joints of the cirri bear circles of hair distally; the mandibles are well developed, with five or six teeth; the maxillae often have the cutting edge scalariform.

The synonymy of the genus thus redefined is discussed by Pilsbry in the paper cited. I have adopted his views on the subject because they seem to be consistent and to tend to simplicity in the classification of the Lepadidae, but it is of course true that the identification of the species described by Quoy and Gaimard and by Rang on the one hand and by Lesson on the other must remain in doubt.

In my own paper to which reference is made I proposed to recognize *Alepas* provisionally as the eponymous genus of a subfamily of somewhat degenerate Lepadidae characterized by their transparent tissues and simplified valves and appendages. It is clear, however, from an examination of the species described below that I was mistaken in my views as to the relationships of the genus, which must be placed near *Conchoderma*. Indeed, the characters whereon the two genera are separated (the thickness of the capitulum, the length of the cirri, the spinulation of these appendages, and apparent differences in the form of the mouth-parts, which are unknown in some species of *Alepas*) are hardly of generic importance unless considered together. Whether some of the other genera (*Chaetolepas*, *Microlepas*, etc.) placed by me in 1909 in the "Lepadinae" should be separated from the Lepadinae is doubtful, but *Anelasma* appears to be very distinct. I have not seen examples of any of these genera.

The different species of *Alepas* have in nearly all cases been found on the umbrella of pelagic medusae. The genus evidently occurs in all warm and tropical seas, but individuals appear to be extremely rare. Specimens identified by Gruvel as *A. parasita*, Sander-Rang, have been taken in the southern part of the Indian Ocean ¹.

Alepas investigatoris, sp. nov.

(Pls. xxxiii, xxxiv, fig. 2.)

The whole animal is white and translucent, except that the cement-glands have a yellowish tinge, which is also present in the

¹ *Bull. Soc. zool. France*, 1907, p. 163.

ova. The scuta are white and opaque.¹ The outline of the capitulum and peduncle is graceful and as a rule markedly sinuous; the relative proportions of the two regions differs considerably in different individuals and probably the peduncle is contractile as well as capable of being twisted and curved in various directions.

The posterior outline of the capitulum is strongly arched, the anterior outline markedly sinuous, strongly convex down the edge of the orifice and almost straight and vertical below it. The apex of the capitulum as seen from the side is slightly produced but not pointed. The whole capitulum is somewhat compressed. As seen from above it is distinctly emarginate in front, a median notch separating its anterior border into two almost rectangular lobes. The sides in this view are sinuous, but roughly parallel; the posterior border broadly rounded. The margins of the orifice are retroverted and a little thickened, but not fringed. The orifice is patent.

The peduncle is slender and cylindrical, a little swollen at the base, a little longer than, as long as, or a little shorter than the capitulum.

The scutum is well calcified, Y-shaped but with the relative lengths of the three arms variable.

The cirri are straight and of moderate length. Those of the first pair are not widely separated from the others, which they resemble in general form though they are considerably shorter than the second pair; each ramus has 8 joints, but the anterior ramus is distinctly shorter than the posterior one. The two basal joints of each are devoid of terminal hairs, but all the other joints bear a complete circle thereof, and also a fringe descending from it for some little distance down the posterior face. The second cirrus has 9 joints in each ramus, a complete circle of hairs at the tip of each joint and an incomplete (distal) marginal fringe in front. The rami of the remaining cirri have from 11 to 14 joints, some of those at the base being sometimes imperfectly differentiated. The terminal circles of hairs are sometimes interrupted on the posterior cirri, but the incomplete marginal fringe is always present at any rate on the last 8 to 10 joints. The sixth cirrus is slightly the longest. In all the cirri the rami are much longer than the undivided basal part of the appendage.

There are no anal appendages, but the position of each is indicated by an indistinct papilla.

There are 5 lateral filaments on each side, situated as follows:—two at the base of the first, one at the base of the third, one at the base of the fourth and one at the base of the fifth cirrus. Each filament is a delicate tapering flattened structure, quite transparent and easily overlooked though of considerable relative size; the first pair are larger than the others, which diminish in size from before backwards.

¹ In some specimens preserved in formalin the calcareous matter has apparently been dissolved out.

The mouth-parts are prominent, but the labrum is not markedly bullate. It is quite smooth. The mandibles have six sharply pointed teeth; the outermost is separated by a considerable gap from the second, towards which it does not converge; the two inner teeth are close together. The inner edge of the first four teeth is pectinate. The whole appendage is minutely pubescent and there is a short fringe of minute hairs on the inner margin within the innermost tooth. The maxilla bears a single stout yellow spine at the outer extremity of its cutting edge but, almost concealed by it, there are two smaller spines on each side; the edge is strongly sinuous with four distinct depressions; it is clothed with soft flattened hairs of various lengths. The inner maxilla is broad and stout, clothed with short soft hairs.

The penis is moderately long and stout, smooth and tapering. It is clothed with fine hairs.

The eggs are remarkably small and numerous. They are invisible individually to the naked eye but form a fairly stout yellowish lamella that appears smooth and homogeneous until examined with a strong lens. They are broadly oval in outline.

Dimensions of largest specimen.

Length of capitulum	..	30 mm.
Breadth of capitulum	..	30 "
Length of peduncle	..	38 "
Breadth of peduncle	..	10 "

Habitat.—Morrison Bay, Mergui Archipelago: on Rhizostomous medusa.

Type.—No. 8711/10, *Crust., Ind. Mus.*

A. investigatoris is closely related to *A. pellucida* (Aurivillius) and *A. pacifica*, Pilsbry, but is apparently distinguished from both by the emargination of the capitulum above, by having five lateral filaments on each side and by its longer cirri, as well as by other characters more likely to be variable.

Two specimens, one large and one small, were found together on the edge of the umbrella of a medusa by Capt. Sewell, while another medusa of about a foot in diameter was surrounded in the same region by a number of individuals of different sizes. None were found on other specimens of the coelenterate examined at the time.

Genus *Heteralepas*, Pilsbry.

Heteralepas (Paralepas) reticulata, sp. nov.

(Pls. xxxiii, xxxiv, fig. 3.)

The capitulum and peduncle are (in spirit) of an opaque slightly yellowish tint, due to the muscular layer, which is covered externally by a thick transparent, tough, quasi-cartilaginous integument. The whole animal is very small.

The capitulum is almost globular; there is no carinal crest, but the posterior part and the sides are covered with a reticula-

tion of deep grooves and in the centre of each mesh there is a projecting tubercle; below the aperture the surface is smooth or marked with irregular (mostly transverse) grooves. No scuta can be distinguished but the outline of a pair of irregular areas is sometimes indicated on the smooth anterior part of the capitulum, in the position they would occupy. The aperture is less than a third as long as the capitulum and can be almost completely closed so as to appear merely as a narrow vertical slit with horizontal grooves extending outwards from it; when open it is subtriangular and surrounded by a distinct fringe: it can evidently also be protruded so as to be almost tubular.

The peduncle is cylindrical. It is rather shorter than the capitulum, but at the base is often produced in front in the form of a tapering flattened process that lies in one of the grooves on the sea-urchin's spine and sometimes is as long or nearly as long as the peduncle.

The cirri are short and feebly curved, but the rami are relatively long as compared with the undivided basal portion. The first cirrus is widely separated from the second and differs considerably in outline from all the others. Its anterior ramus is much the shorter and more slender of the two (although each has 8 joints) and is nearly cylindrical in form. The posterior ramus tapers to a point, and is considerably swollen at the base. In both rami the apical part of each joint bears a more or less incomplete circle of very stout bristles; on the basal joint of the posterior ramus the circle is widely interrupted posteriorly. On the anterior ramus the circle is so deep that it occupies a half or even two-thirds of some of the joints. The other cirri are similarly armed, but the circles of bristles, which are complete on the anterior cirri and laterally interrupted on the posterior ones, are not so deep.

The anal appendages are long and slender, having 7 or 8 joints, the tip of each of which is surrounded by a sparse circle of long but very fine hairs. The distal part of the appendages is much attenuated.

The penis is slender and smooth, much contorted in the preserved specimen and clothed with fine hairs.

The mouth-parts are very prominent. The labrum is not bullate; it bears a semicircle of minute, blunt chitinous teeth. The mandible has four teeth, of which the outermost is the largest. It is rather widely separated from the second tooth, towards which it is slightly curved. The remaining three teeth are straight, subequal and equidistant; the second and third are sharply pointed; their inner margin bears several short stout spines that give it a pectinate appearance. The innermost tooth is minutely bifid or trifid and bears on its inner edge several irregular projections and a fringe of fine hairs similar to those that cover the greater part of the body of the appendage. The cutting edge of the maxilla is definitely scalariform, with four distinct steps; it bears numerous stout bristles. The second

maxilla is slender; it is armed with hairs of varying size, some of them moderately stout and long.

Dimensions of a large specimen.

Length of capitulum	.. 5 mm.
Breadth of capitulum	.. 3.5 ,,
Length of peduncle	.. 3 ,,
Thickness of peduncle	.. 2 ,,

Habitat.—Mergui Archipelago: 60 fathoms ('Investigator' sta. 534): on spines of Cidarid sea-urchin, with *Scalpellum sinense*.

Types.—No. 8713/10 *Crust.*, *Ind. Mus.*

The external appearance of this species is very characteristic and will at once distinguish it from any other of the genus.